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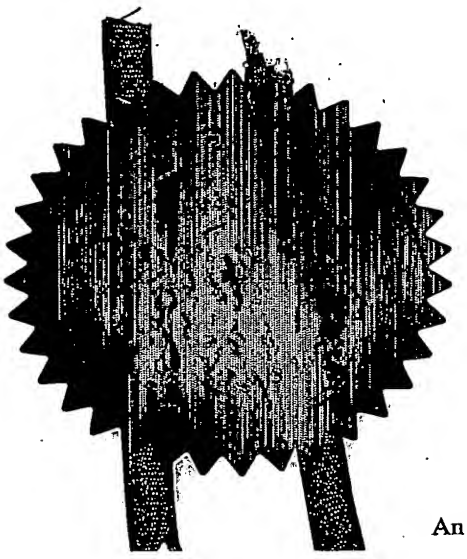

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Dated 21 March 2003

Form 1/77

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1/77

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
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NP9 1RH

1. Your reference — XA1621

2. Patent application number *(The Patent Office will fill in this part)* — GB 0205565.5

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

BAE SYSTEMS plc

6 Carlton Gardens
London
SW1Y 5AD

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — United Kingdom

4. Title of the invention — EXPLOSIVES LINER

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

BAE SYSTEMS plc
Group IP Department
Lancaster House, P.O. Box 87
Farnborough Aerospace Centre
Farnborough, Hampshire, GU14 6YU

Patents ADP number *(if you know it)* — 07914674002

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

s Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	06
Claim *(s)*	02
Abstract	01
Drawing *(s)*	01

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature Mark Bone-Knell Date 08/03/2002

12. Name and daytime telephone number of person to contact in the United Kingdom Maria Burkes 01252 383487

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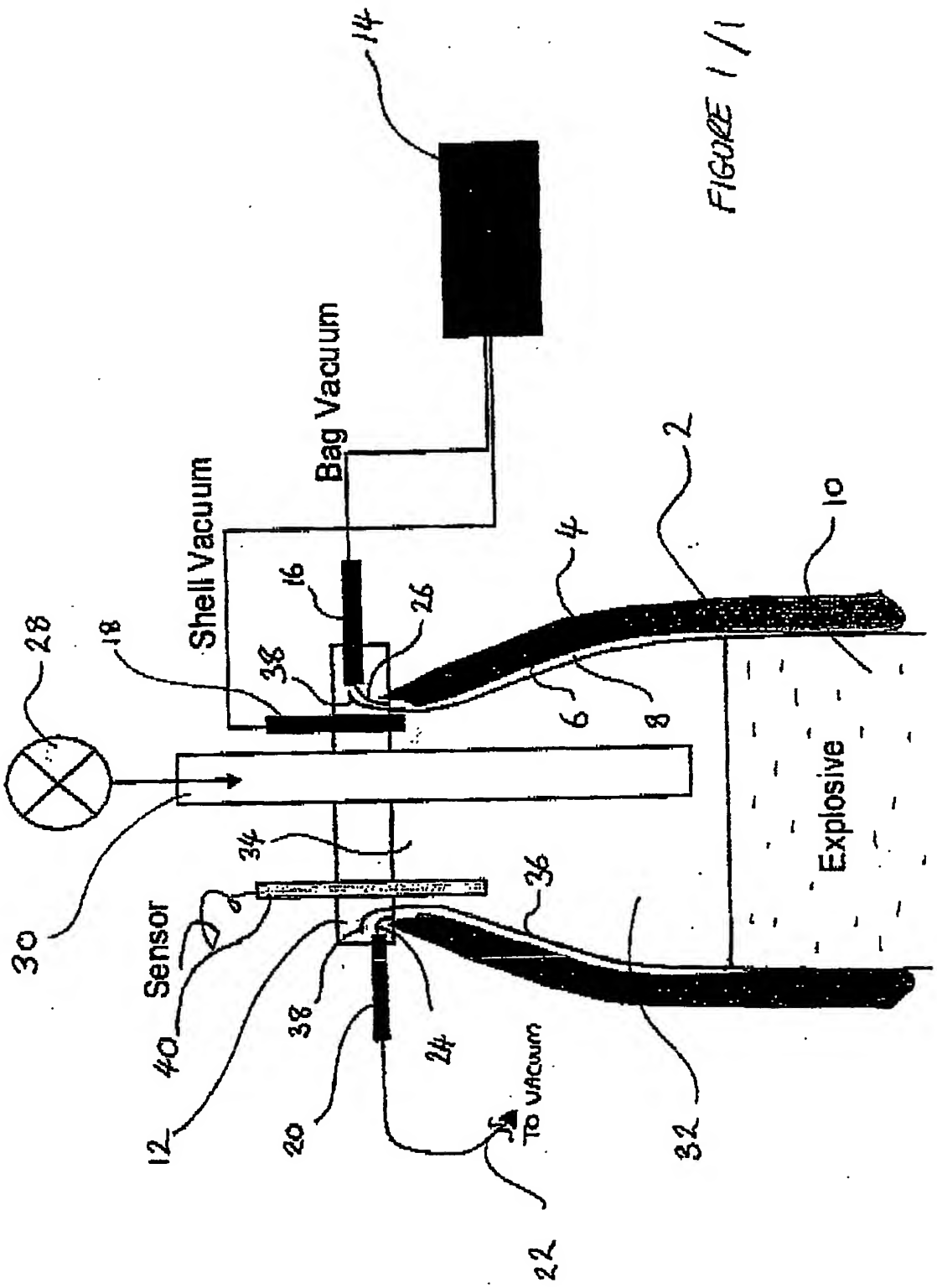

FIGURE 1/1

XA1621

EXPLOSIVES LINER

This invention relates to the field of the filling of ordnance with explosive materials.

Traditional methods used for filling ordnance with polymer bonded explosive (PBX) utilise a filling process based on the combination of usually two materials (explosive mixture (pre-mix) and hardener), which are mixed together and injected into the volume reserved for explosive materials usually at the tip of the ordnance.

In a typical application of the mixing and filling process, a pre-mix of explosive is produced and typically mixed with a hardener (i.e. IPDI) the mixture mixed together to produce a combined final explosive material (e.g. PBX).

Ordnance to be filled is typically placed in a vacuum chamber and a filling attachment from the bottom outlet valve of the mixer bowl containing the fully mixed PBX composition is attached to the chamber. Typically the vacuum will be evacuated to < 50 millibars.

The vacuum provides the physical motivation for the fully combined final explosive material to flow into the ordnance. However, the interaction of the combined final explosive material and the inner surface of the volume to be filled can lead to problems in terms of the inadvertent adhesion of the material to the sides of the volume during filling, thereby introducing the possibility of an imperfect fill of the explosive cavity. An imperfect fill of explosives may result in ordnance failing safety acceptance tests, the ordnance being liable to early

detonation due to the movement of explosive material within the ordnance as it is launched.

In addition to the problems associated with the issue of imperfect fill, ordnance can be subject to environmental cycling, including temperature cycling, which can cause the explosive material contained within the ordnance to lose some of its required physical characteristics.

The problems associated with imperfect fill and environmental cycling are known in the art and attempts to solve the problem have been made by the use of approaches such as liners sprayed or poured onto the inner surface of the explosives cavity or volume within the ordnance. This liner would in turn adhere to the wall of the explosives volume in an attempt to reduce the effects of explosive adhesion and environmental cycling.

However, the problems associated with the state of the art solutions relate to the fact that the liner does indeed adhere to the wall of the explosives volume, and consequently the explosive filling thereby suffers from some of the effects induced by enviromental/temperature cycling and physical vibration that would have also been observed had no liner been present.

Additionally, when ordnance is required to be disposed of at the end of its service life explosive materials comprising PBX cannot be effectively 'boiled out' as in the case of TNT based explosives, and an expensive decommissioning process has to be put in place requiring the effective cutting in two or more parts of the ordnance, to allow for the extraction of the PBX explosives which will have adhered to the inner wall of the explosive volume.

The invention described herein provides for apparatus and a method for reducing the problems associated with the filling of explosives, especially in the case of explosives comprising PBX materials and the like, and for drastically reducing the effects of environmental and temperature cycling on the physical quality of the explosive filling.

Additionally the invention described herein provides for an improved method of decommissioning ordnance containing PBX based explosives and the like.

Accordingly there is provided ordnance comprising a cavity filled with explosive material, said explosive material being contained in a bag within said cavity.

In a first preferred embodiment of the invention the bag is made of an elastomeric material.

Preferably said elastomeric bag will have a volume less that that of the explosives cavity of said ordnance.

In a further preferred embodiment of the invention the elastomeric bag will have a volume in the range 5% to 10% less than that of the explosives cavity of said ordnance.

Additionally there is provided a method of filling ordnance with explosive materials, comprising the use of a bag in accordance with another aspect of the invention, said bag being inserted into the explosives cavity of said ordnance, said bag then being filled with explosive materials.

In a further preferred embodiment of the invention a bag in accordance with the invention is forced against the walls of said explosives volume by the action of a vacuum source.

The invention is now described by way of example only with reference to the following drawing, in which figure 1 is a diagrammatic representation of an explosives filling bag and ordnance filling apparatus in accordance with the invention.

Figure 1 shows a top section of an ordnance shell 2 being filled with explosive material 10, the ordnance having both an outer surface 4 and an inner surface 6, the inner surface describing a-cavity 32 for housing explosive material 10.

Explosive material 10 enters the cavity 32 via a filling tube 30, the flow of the explosive material into the cavity 32 being controlled by a valve 28.

A vacuum filling attachment 12 is secured over the aperture 34 describing the opening in the cavity 32 such that a substantially airtight seal is produced between the atmosphere and the volume within the cavity 32. Vacuum means 14 is provided, the vacuum means 14 being connected to the filling attachment 12 such that any gas such as air within the cavity 32 can be partially or wholly evacuated by the action of the vacuum port 18 thereby providing a motivating force for explosive material to flow through the valve 28 when opened, down the filling tube 30 and into the cavity 32.

Additional vacuum ports 16 and 20 are also shown, the vacuum line shown at 22 shown stopped for illustrative purposes only but actually returning to the vacuum source 14.

An elastomeric bag 36 is shown held within the cavity 32 of the ordnance 2 by the vacuum filling attachment 12. The main vacuum ports 16 and 20 have corresponding smaller ports to enable a vacuum to be created within the space 8 described by the bag 36 and the inner wall 6 of the cavity 32. The action of this vacuum in extracting gas such as air from within the cavity 8 provides the force required to hold the bag 36 against the inner wall 6 of the cavity 32 thereby providing a bag lined cavity 32 into which the explosive material 10 can be injected.

In order to maintain contact between the bag 36 and the inner wall 6 in the presence of the vacuum force generated within the cavity 32 by the vacuum port 18, there must be a differential in the two vacuums produced in favour of the bag vacuum.

The diagram shows a fibre optic light sensor present within the cavity 32, the sensor 40 providing a method of sensing the fill volume of the explosive 10 within the cavity 32. The output from the sensor 40 can be fed back to a control means for effecting the action of the valve 28 and indeed aspects of the explosives process not shown.

The decommissioning of ordnance comprising a bag in accordance with the invention is simplified over the now prior art. The bag can be manufactured with an anti-adhesion surface to prevent adhesion between the bag and the inner lining of the cavity. Alternatively, the cavity lining itself can be treated with an anti-adhesion material prior to introducing the bag. When subsequently decommissioning the ordnance, the bag containing the explosives can be removed as a whole (if the ordnance design allows) thereby reducing the exposure of the person decommissioning the ordnance to the explosive material. Where the ordnance design does not allow removal of the bag

containing the explosives as a whole (e.g. in the case of artillery shell) then a single transverse cut across the major internal diameter of the ordnance should allow the bag containing the explosives to be easily removed in two parts.

The other advantages of the invention will be readily apparent to those skilled in the art and the substitution of elements for mechanical equivalents and adaptation of the process using different materials and the like should be construed as being comprised within the inventive concept as claimed.

References to ordnance in the above specification and claims shall be construed as non-limiting and in respect of the invention shall include without limitation shells, mortars, rockets, bombs, warheads, projectiles and any other weapons or containers which are required to be filled with a combined explosive mixture.

CLAIMS

1 Ordnance comprising a cavity filled with explosive materials, said explosives material being contained in a bag within said cavity.

2 Ordnance in accordance with the invention described in claim 1 wherein the bag is made of an elastomeric material.

3 Ordnance in accordance with the invention described in claim 1 or claim 2 wherein said bag has a volume less than that of the explosives cavity of said ordnance.

4 Ordnance in accordance with the invention described in claims 1 2 or 3, wherein the bag will has a volume in the range 5% to 10% less than that of the explosives cavity of said ordnance.

5 A method of filling ordnance with explosive materials, comprising the use of a bag in accordance with any of claims 1 to 4 wherein, said bag is inserted into the explosives cavity and filled with explosive materials.

6 A method of filling ordnance with explosive materials in accordance with claim 5, wherein the bag is forced against the inner walls of the explosives cavity by the action of a vacuum.

7 A method of filling ordnance with explosive materials in accordance with claim 5 or 6 wherein a differential vacuum is produced between the bag and inner cavity wall and the main explosives cavity.

8 A method of filling ordnance with explosive materials in accordance with claims 5, 6 of 7, further comprising the use of fill-to-level control means utilising at least one fibre optic sensor.

9 Ordnance substantially as hereinbefore described with reference to the accompanying drawings.

10 A method of filling ordnance with explosive materials substantially as herein before described with reference to the accompanying drawings.

ABSTRACT

Ordnance comprising a cavity filled with explosive materials, the explosive material being contained in a bag within the cavity.

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ABSTRACT

ORDNANCE WITH EXPLOSIVES LINER

Ordnance (e.g. a shell 2), comprising a cavity filled with explosive materials (10) the explosive material being contained in a bag (36) within the cavity. DURING THE FILLING OF THE BAG WITH THE MATERIAL 10, THE BAG IS FORCED AGAINST THE INNER WALL 6 OF THE CAVITY 32 BY THE ACTION OF A DIFFERENTIAL VACUUM.